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Canadian Science Advisory Secretariat
Science Response 2017/028

Maritimes Region

WESTERN COMPONENT (4Xopqrs5) POLLOCK HARVEST CONTROL RULE UPDATE AND INDICATORS REPORT

Context

Pollock (*Pollachius pollachius)* in Northwest Atlantic Fisheries Organization (NAFO) Areas 4VWX5 comprise two population components: a slower-growing Eastern Component including Divisions 4V and 4W, as well as Unit Areas 4Xm and 4Xn, and a faster-growing Western Component (WC) including 4Xopqrs and Canadian portions of Area 5. The WC has been the main focus of past analytical assessments, but scientific advice on stock status and catch limits using Virtual Population Analysis (VPA) modeling has been highly variable, especially since the mid-2000s. For example, the 2008 assessment indicated that Age 4+ population biomass was at 27,000 metric tonnes (mt) (Stone et al. 2009), while the 2010 assessment update indicated Age 4+ population biomass was either 23,000 mt or 17,000 mt, depending on whether the very low 2010 DFO Summer Research Vessel (RV) Survey indices were excluded or included in the analysis (Stone 2011). Consequently, the Canadian fishing industry recommended exploration of alternative approaches that would provide more stability in future catch limits to allow for better business planning and a more stable fishery.

In 2011, fisheries managers and the fishing industry decided to manage WC Pollock using a risk-management approach and embarked on a Management Strategy Evaluation (MSE) process, with the help of government scientists and outside experts (DFO 2011). MSE is a technique to explicitly consider the uncertainty in stock assessment assumptions and models, and to compare the likely consequences to Management Objectives when a predetermined Management Procedure (MP) incorporating a Harvest Control Rule (HCR) is applied. The Pollock MP was selected on the basis of satisfying three medium-term objectives agreed upon for management of the resource, which relate to sustainability, catch levels, and the extent of annual catch changes. The MP model was built around a HCR that either increased or decreased future catch limits based on results from ongoing monitoring from the annual DFO Summer RV survey. An Exceptional Circumstances Protocol was put in place to cover situations that fall outside the range for which the MP was simulation tested and, if necessary, to allow for some form of intervention.

Recently, Fisheries Management posed the following question to Science: What is the Western Component catch level for fishing year (FY) 2017/2018 generated by the HCR described in DFO 2011 "*Western Component Pollock Management Strategy Evaluation*"? This report provides an update to the 2015 report (DFO 2016) on the WC Pollock HCR and provides advice on the FY 2017/2018 catch limit generated by the Pollock MP and HCR using updated information from the 2016 DFO Summer RV survey. It also describes current status with respect to the provisions in the Exceptional Circumstances Protocol. The HCR, with updated monitoring data for 2016, generated a catch limit of 2,670 mt for FY 2017/2018 and up 20% from 2,225 mt for FY 2016/2017. The DFO Summer RV survey biomass index increased from 4.55 kg/tow in 2015 to 28.15 kg/tow in 2016 and, therefore, did not trigger the exceptional circumstance provision of the DFO Summer RV survey biomass index being < 6 kg/tow for two consecutive years and the Survey Index Ratio being < 0.2.

At the MSE framework in 2011, a full review of the Pollock MP and its HCR was proposed for 2016; however, at this time Fisheries Management and Industry requested a preliminary review of the HCR data inputs. This update report provides a review of additional indices of WC Pollock biomass from the U.S. National Marine Fisheries Service (NMFS) Spring and Fall surveys, and recent DFO Summer RV survey coverage of eastern Georges Bank. Applying updated DFO Summer RV survey data to the FY 2016/2017 Total Allowable Catch (TAC) was also examined. Updated information on commercial catch-at-age, fish condition, and mean lengths-at-age are also discussed.

This Science Response Report results from the Science Response Process of December 13, 2016, on the Stock Status Update of Western Component (4Xopqrs5) Pollock Harvest Control Rules.

Analysis and Response

DFO Summer Research Vessel Survey Index

The DFO Summer RV survey time series for the WC Pollock biomass index (kg/tow) extends from 1984-2016; a period when the same survey design and bottom trawl (Western IIA) have been used annually (Figure 1). The index is based on survey strata representing unit areas 4Xopqrs+5Yb and does not include 5Zc (eastern Georges Bank). The biomass index exhibits strong year-effects, which reflect the semi-pelagic schooling behavior of Pollock and changes in availability arising from differing distributions in the water column at the times of the survey. In general, there has been a declining trend in the index since the late 1980s, an increasing trend from 2003-2007, followed by another decline to 2012. While the index increased in 2013, it declined in 2014 and 2015 before increasing again in 2016. Although the index is highly variable, the long-term trends are informative. The DFO Summer RV survey series, using a 3-year geometric mean (GM) (3-year moving average), provides a clearer indication of long-term trends by smoothing year effects and provides the monitoring data used in the HCR for calculating future catch limits (Figure 1).

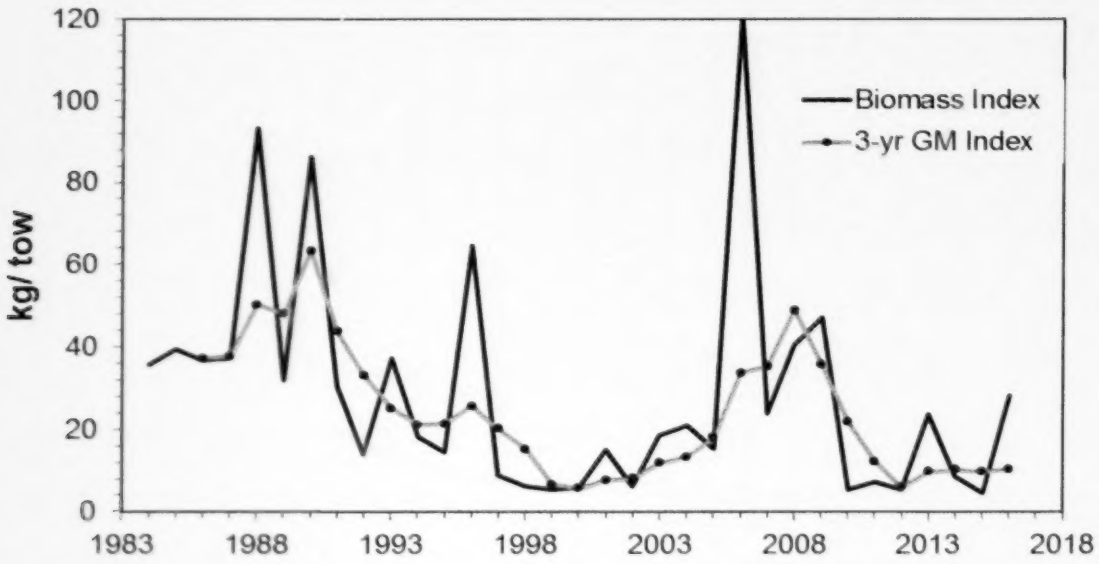

Figure 1. DFO Summer Research Vessel survey biomass index and 3-year geometric mean (GM) index based on survey strata representing unit areas 4Xopqrs+5Yb, 1984-2016.

Harvest Control Rule

The Pollock MP is linked to the HCR to calculate catch limits based on results from ongoing monitoring (DFO Summer RV survey). The catch limit either increases or decreases by up to 20% annually (with increases capped at 500 mt) depending on Survey Index Ratio, which is the value of the GM biomass index for the most recent 3 years (i.e. 2014-2016) as a proportion of the GM of the index for 1984-1994, a period of high productivity. The catch limit was initially set at 6,000 mt in 2011 for the Pollock MP Model and the maximum permitted decrease limit (20%) has been applied every year from FY 2011/2012 to FY 2014/2015 and in FY 2016/2017. The survey biomass index decreased from 8.53 kg/tow in 2014 to 4.55 kg/tow in 2015, the lowest value in the time series (1984-2016). In 2016, the survey biomass index increased to 28.15 kg/tow, the highest index since 2009. However, because the index was low in 2015 (4.55 kg/tow), the 3-year GM value for 2014-2016 shows only a modest increase to 10.29 kg/tow and the resultant Survey Index Ratio is now 0.28. Based on this value, the HCR calculates a catch limit of 2,670 mt for FY 2017/2018, which is the maximum permitted increase of 20% from the 2016/2017 catch limit of 2,225 mt.

Exceptional Circumstances Protocol

There are provisions to cover situations outside the range for which the Pollock MP Model was simulation tested or beyond situations that the management procedure was designed to handle. These provisions can be applied by decision-makers to amend the catch limits set by the Pollock MP or to revise the MP itself but this should not be a frequent occurrence.

Results that would trigger an exceptional circumstance based on the protocol established in DFO 2011 include:

1. ***When the Survey Index Ratio Falls below 0.2 or is beyond the 90% probability level from model predictions.***

The current Survey Index Ratio (based on the 3-year GM survey index for 2014-2016 as a proportion of the index for 1984-1994) is 0.28, which is above the exceptional circumstance value of 0.2.

2. ***When the RV survey biomass index is < 6.0 kg/tow for two consecutive years.***

The RV index was 28.15 kg/tow in 2016 and 4.55 kg/tow in 2015, which does not trigger an exceptional circumstance.

3. ***Additional situations.***

Research Vessel survey age-specific indices are monitored for changes in age structure that could also trigger an exceptional circumstance (i.e. when extremely compressed/expanded). There has been a period of diminished numbers-at-age for older ages from 1995-2005, with some modest improvement since then (Figure 2). The recent age structure indicates some improvements in the numbers of fish in the population older than Age 7, but the number of older fish remains low.

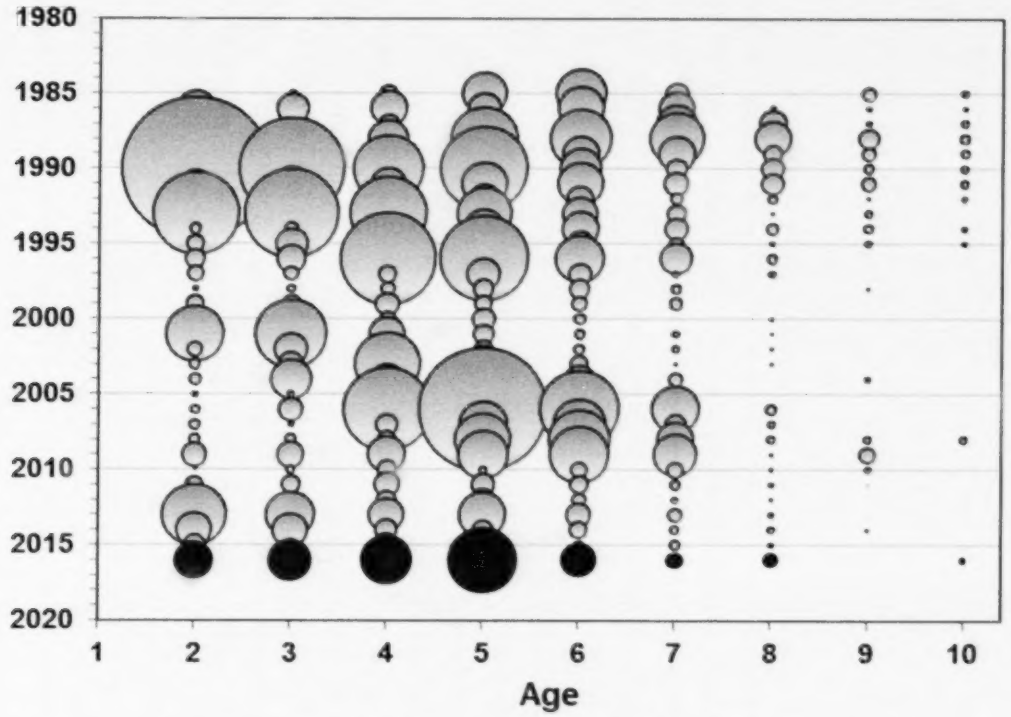

Figure 2. Stratified mean number-per-tow at age for Pollock from the DFO Summer Research Vessel survey based on strata representing Unit Areas 4Xopqrs+5Yb for ages 2-10, 1985-2016. The index values for the 2016 survey are shown in black. Bubble size is proportional to the stratified mean number-per-tow at age.

Review of Harvest Control Rule and Biological Indicators

In response to the request from Resource Management, a review of additional biomass indices for WC Pollock from the NMFS Spring and Fall surveys, and recent DFO Summer RV survey coverage of eastern Georges Bank, was undertaken. The HCR provided a catch limit in FY 2016/2017 of 2,225 mt, but the TAC was set at 3,081 mt, therefore the updated DFO Summer RV survey biomass index was also applied to the FY 2016/2017 TAC. Updated information on commercial catch-at-age, fish condition, and mean lengths-at-age are also discussed.

The DFO Summer RV survey biomass index is based on survey strata representing unit areas 4Xopqrs+5Yb and does not include 5Zc (eastern Georges Bank). Recently, there have been concerns by the fishing industry regarding the lack of survey coverage on Georges Bank, where they have been catching WC Pollock. NMFS conducts bottom trawl groundfish surveys that cover part of the WC management unit and includes eastern Georges Bank, but unlike the DFO Summer RV survey, the NMFS surveys occur in the spring and fall. All three surveys are subject to high inter-annual variability in Pollock abundance (Figure 3). NMFS survey biomass indices were scaled to the DFO Summer RV survey. Scaling was achieved by taking an average of the indices for 1984-1994 (the same reference period used for the DFO survey index in the HCR) and each NMFS survey index from 1984-2016 was divided by its reference period average then multiplied by the DFO Summer RV survey average index. An average index of the three scaled survey indices was calculated for 1984-2016. Finally, the combined multi-survey 3-year GM was calculated and compared to the DFO Summer RV survey 3-year GM used in the HCR (Figure 4). In general, including the NMFS survey biomass indices results in a similar trend as the DFO Summer survey for 1984-2005 and 2008-2013; however, in recent years (2014-2016) the combined multi-survey 3-year GM index has been increasing while the DFO 3-year GM index has remained relatively stable at a low level. The combined multi-survey index may be more closely reflective of the biomass trend due to reduced uncertainty from survey catchability and coverage. It should be noted that the 2016 NMFS Fall survey was not completed at the time of the update report and is therefore not included in the calculations.

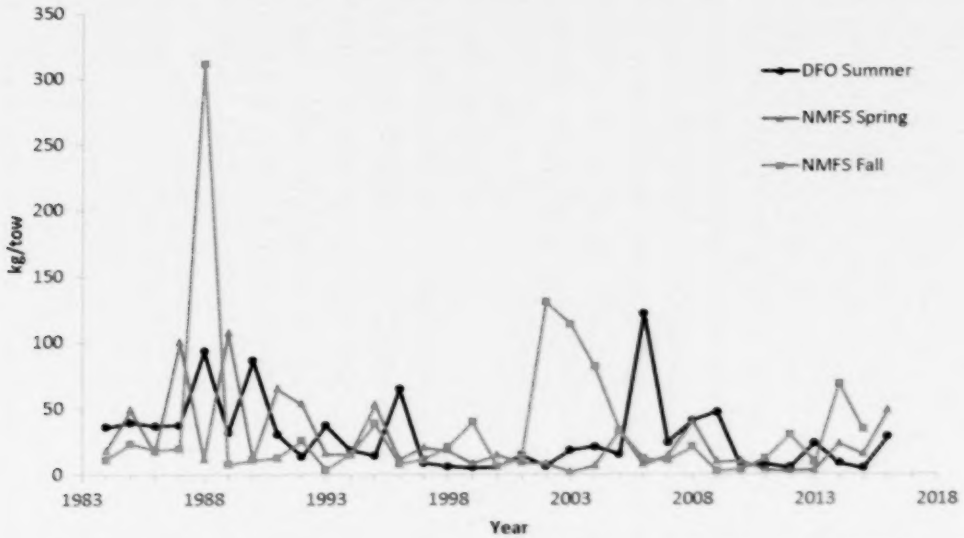

Figure 3. Western Component Pollock biomass indices, scaled to the DFO Summer Research Vessel (RV) survey mean (1984-1994) for the DFO Summer RV (black line), NMFS Spring (red line), and NMFS Fall (blue line) surveys from 1984-2016.

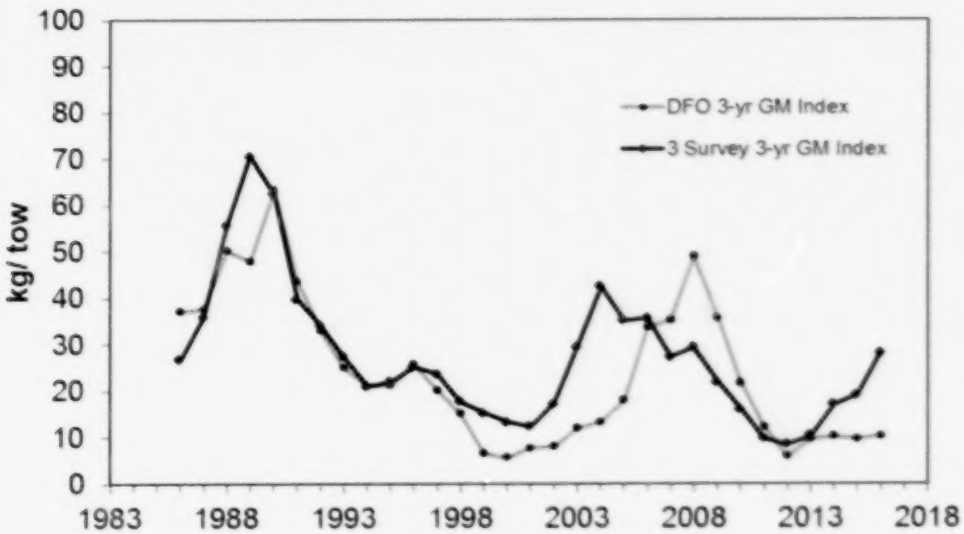

Figure 4. 3-year geometric mean (GM) index for the DFO Summer Research Vessel (RV) survey based on strata representing unit areas 4Xopqrs+5Yb, 1984-2016 (red line), and the 3-year GM index for the DFO Summer RV survey and NMFS Spring and Fall surveys combined (black line). NMFS survey biomass indices are scaled to the DFO Summer RV survey mean (1984-1994) and represent unit areas 4Xopqrs+5Yb+5Zc.

In recent years, the DFO Summer RV survey has included some coverage of eastern Georges Bank including strata 5Z9 (2011-2016), 5Z1 (2011-2013, 2016) and 5Z2 (2016). With the exception of 2016, the survey coverage on Georges Bank has been minimal and the indices from these data are likely a poor representation of Pollock biomass in unit area 5Zc. In most

years, including survey coverage from eastern Georges Bank generates a very similar biomass index to the current survey coverage in 4Xopqrs+5Yb with the exception of 2011 and 2016 where the index is higher when Georges Bank data are incorporated (Figure 5).

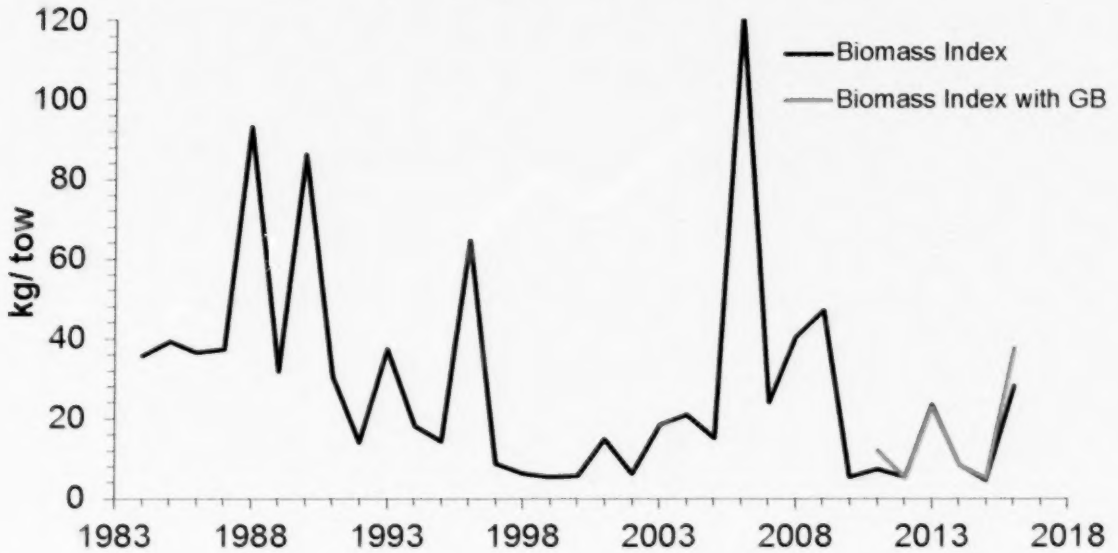

Figure 5. DFO Summer Research Vessel (RV) survey biomass index based on strata representing unit areas 4Xopqrs+5Yb, 1984-2016, and the DFO Summer RV survey biomass index for strata representing unit areas 4Xopqrs+5Yb+5Zc, 2011-2016.

The 2016/2017 FY TAC for WC Pollock was set at 3,081 mt. When the 2016 DFO survey biomass index of 28.15 kg/tow is applied to the 2016/2017 TAC, the HCR calculates a catch limit of 2,939 mt for FY 2017/2018. Even though the biomass index increased significantly in 2016, the catch limit only increased by approximately 6%. This is because the index in 2015 was low (4.55 kg/tow) and the 3-year GM value for 2014-2016 shows only a modest increase to 10.29 kg/tow from 9.69 kg/tow in 2015 (Figure 1).

Commercial catch-at-age for WC Pollock was updated to 2015 and displays a similar trend as the DFO Summer RV survey, further indicating a truncated age-structure and few fish in the population older than Age 7 (Figure 6). Fulton's condition factor (K) for the DFO Summer RV survey dropped below the long-term average in 2010 to the lowest in the time series (1984-2016) before slowly increasing to above average in 2014 and has since decreased to below average in 2015 and 2016 (Figure 7). The mean lengths-at-age for all ages (1-10) are variable with no obvious trends over the time series (1985-2016) for both the DFO Summer RV survey and fishery. A decrease in mean length-at-age for Age 10 Pollock from the fishery occurred in 2008 to a mean length similar to Age 9 Pollock and has remained similar in recent years (Figure 8).

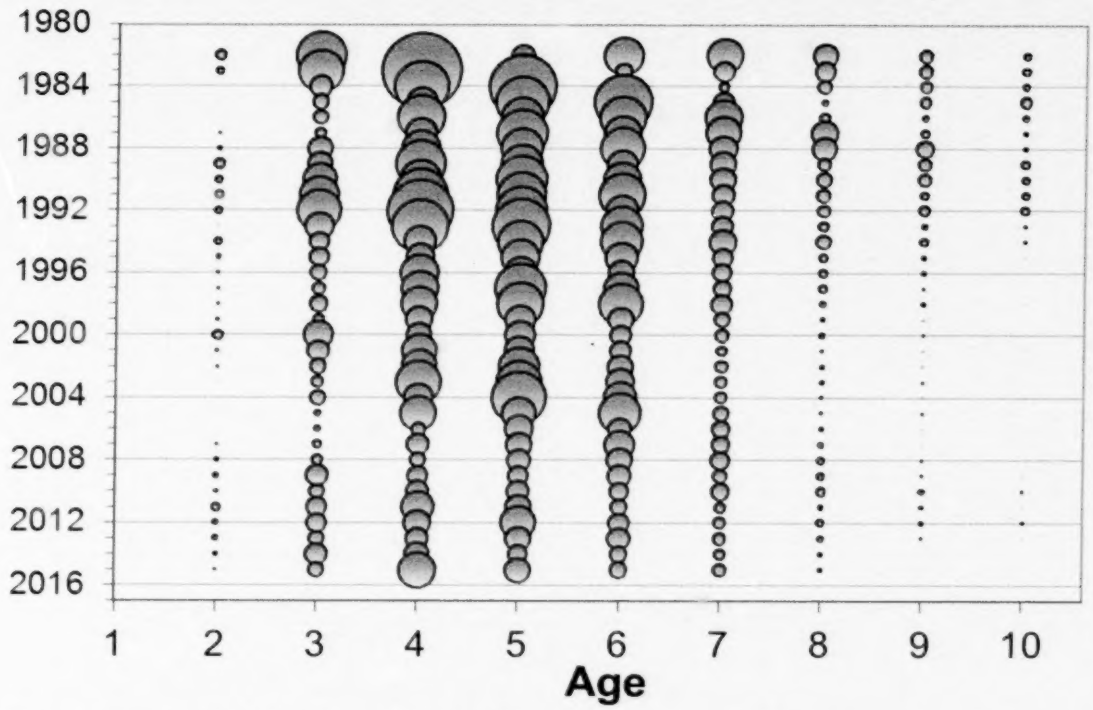

Figure 6. Commercial catch-at-age (numbers) for Western Component Pollock based on unit areas 4Xopqrs+5YbZc for ages 2-10, 1982-2015. The bubble area is proportional to the magnitude.

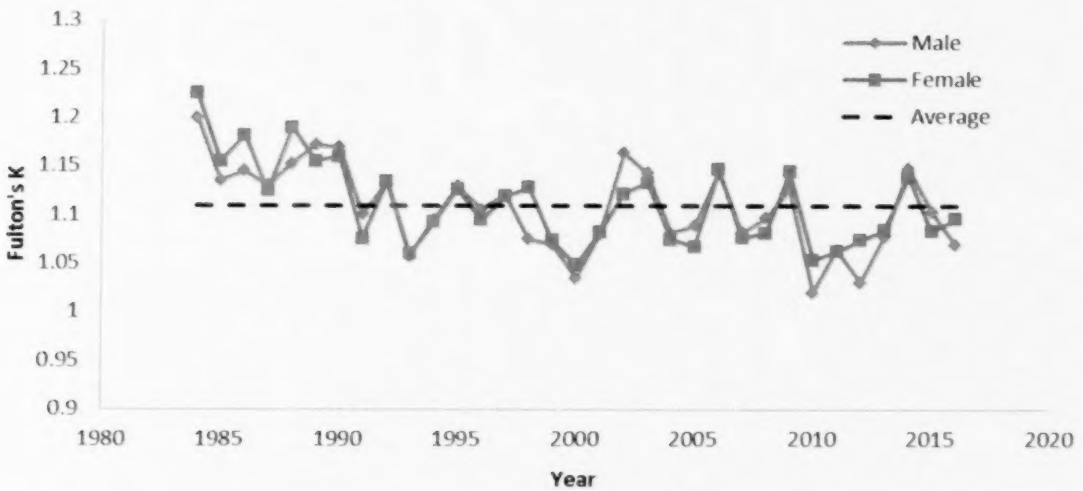

Figure 7. Fish condition (Fulton's K) of Western Component Pollock from the DFO Summer Research Vessel survey based on strata representing unit areas 4Xopqrs+5Yb, 1984-2016.

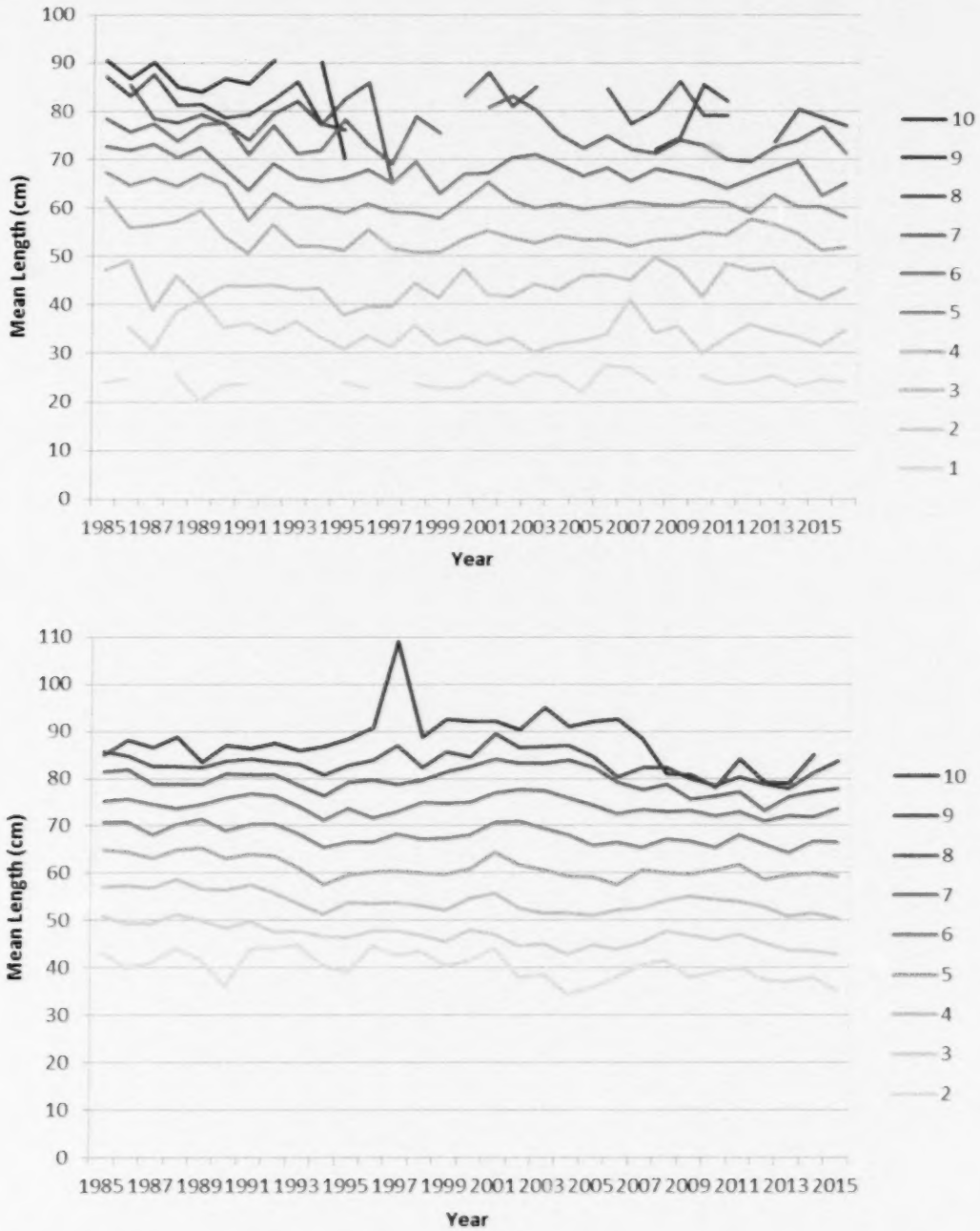

Figure 8. Mean length-at-age of Western Component Pollock from the DFO Summer Research Vessel (RV) survey (top) and port sampling program (bottom). Mean lengths-at-age from the port sampling program include catches from Georges Bank (5Zc) while the DFO Summer RV survey does not.

Conclusions

Using updated monitoring data, the HCR calculates a catch limit of 2,670 mt for WC Pollock for FY 2017/2018, which is up 20% from the catch limit of the previous year. The 2016 DFO survey biomass index is the highest since 2009.

The Pollock MP and its HCR have responded to declining trends in the survey biomass index for WC Pollock by decreasing the catch limits since 2011. The increase in the 2016 DFO Summer RV survey biomass index has resulted in an increase in the catch limit reported in the current update. Since the inception of the HCR in 2011, no exceptional circumstance has been triggered.

This report provides a preliminary review of additional biomass indices of WC Pollock from the NMFS Spring and Fall surveys and recent DFO Summer RV survey coverage of Georges Bank. Incorporating a new data input time series within the current HCR framework would require a detailed analysis involving comparisons with the original operating models used in the Pollock MSE, which is beyond the scope of this update. Regardless of the data source, indices of Pollock biomass continue to be highly variable further emphasizing the need for exploration of improved indices of abundance and the importance of a HCR designed to reduce erratic changes in catch limits.

Contributors

Name	Affiliation
Ryan Martin (Lead)	DFO Science, Maritimes Region
Quinn McCurdy	DFO Science, Maritimes Region
Don Clark	DFO Science, Maritimes Region
Kirsten Clark	DFO Science, Maritimes Region
Heath Stone	DFO Science, Maritimes Region
Mike Fowler	DFO Science, Maritimes Region
Monica Finley	DFO Science, Maritimes Region
Yanjun Wang	DFO Science, Maritimes Region
Lottie Bennett	DFO Science, Maritimes Region
Jen Ford	DFO Resource Management, Maritimes Region
Corina Busby	DFO Fish Population Science, National Capital Region

Approved by

Alain Vézina
Regional Director of Science, DFO Maritimes Region
Dartmouth, Nova Scotia
Ph. 902-426-3490
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Sources of Information

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Center for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive, PO Box 1006
Dartmouth, Nova Scotia B2Y 4A2

Telephone: 902-426-7070
E-Mail: XMARMRAP@mar.dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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